

# **DOES LOW BIRTHWEIGHT INCREASE THE RISK OF CARIES? A SYSTEMATIC REVIEW**

Brian A. Burt, BDS, MPH, PhD

Satishchandra Pai, BDS, MPH

School of Public Health  
University of Michigan  
109 Observatory Street  
Ann Arbor, MI 48109-2029

Presented at the Consensus Development Conference on Diagnosis and Management of Dental Caries Throughout Life, March 26-28, 2001.

Natcher Conference Center  
National Institutes of Health  
Bethesda, MD

Author for correspondence:

Dr. Brian A. Burt  
University of Michigan  
School of Public Health  
109 Observatory Street  
Ann Arbor, MI 48109-2029  
Phone: 734-764-5478  
Fax: 734-764-3192  
E-mail: [bburt@umich.edu](mailto:bburt@umich.edu)

**ABSTRACT:**

Low birthweight is a major public health and social problem in the United States. While a long list of mortality and morbidity conditions have been associated with low birthweight, dental conditions have not received much attention. This systematic review addresses this question: Do low-birthweight children (birthweight <2500 grams) subsequently develop more caries than do children with normal-to-high birthweight? The MEDLINE and EMBASE databases were searched for English-language papers published between January 1966 and July 2000 using a search expression developed in conjunction with an experienced librarian. There were 198 papers located in the initial search, a title and abstract review to identify clearly irrelevant papers reduced this number to 37. Two readers each read these papers, and application of predetermined inclusion/exclusion criteria reduced this number to only four papers. Quality criteria were established for scoring each of these papers on evidence tables. The maximum score for each paper was 100, the four papers rated scored between 31 and 61. Results showed that no relationship between low birthweight and subsequent development of caries was reported in any of the four papers. However, conclusions must be cautious because of the scarcity of studies on the subject and the limited scope of the four papers judged. The relationship of low birthweight to subsequent development of caries, especially in the permanent dentition, needs further exploration.

**Keywords:** infants, low birthweight, caries, enamel defects.

Data from the NCHS website show that in 1997, 7.5% of all live births in the United States were babies of low birthweight ([www.cdc.gov/nchs/about/otheract/hp2000/childhlt/14cpt.pdf](http://www.cdc.gov/nchs/about/otheract/hp2000/childhlt/14cpt.pdf)). Low birthweight is when the newborn weighs 2,500 grams or less. There were 1.4% of all births classed as very low birthweight, which is under 1,500 grams. Low birthweight mostly is found with preterm birth, and like many other social and health measures is found disproportionately among the poor and deprived. One likely reason for low birthweight, though by no means the only one, is poor maternal nutrition during pregnancy. Low birthweight is a public health issue because it is closely related to infant mortality and a host of morbidity conditions. Children of low birthweight are at increased risk of cerebral palsy, seizure disorders, severe mental retardation, and lower respiratory tract infections, among others. Risk factors for low birthweight include maternal age (both <17 and >34 years), low socioeconomic status, the mother's being unmarried, the mother smoking during pregnancy, and poor obstetric care during pregnancy. One especially depressing fact about low birthweight is that the proportion of low birthweight births has remained fairly constant in the United States over the last 30 years ([www.cdc.gov/nccdphp/drh/dataact/pdf/birout3.pdf](http://www.cdc.gov/nccdphp/drh/dataact/pdf/birout3.pdf)).

The relationship between low birthweight and dental conditions has not received much attention, and most of what has been done looks at enamel defects, such as hypoplasia, in low birthweight infants. Little is known about whether low birthweight infants are more prone to develop caries in later life, but if maternal under-nutrition during pregnancy is involved then such a link could be hypothesized. This systematic review therefore addresses the following question: Do low-birthweight children (birthweight <2500 grams) subsequently develop more caries than do children with normal-to-high birthweight?

## MATERIAL AND METHODS

The review consisted of a search of the MEDLINE and EMBASE databases for papers published between January 1966 and July 2000. Reports to be considered for inclusion in the review were those in the English language and which used cohort, case-control, or cross-sectional research designs with human subjects. The exclusion criteria we used to reject papers from consideration are shown in Table 1. Search terms included: low birthweight, normal birthweight, premature birth, maternal nutrition, nutrition in pregnancy, enamel hypoplasia, hypomineralization, hypomineralized enamel. A set of search terms for caries was drawn up by an experienced librarian (the full search expression is available from the authors by request).

Table 2 shows the results of the search and its subsequent use. The initial search produced a total of 198 reports. The first assessment made was by title and abstract, and clearly-irrelevant articles were discarded at this point. This process reduced the original 198 reports to 37. These 37 papers were then read in full by two readers. Another 33 papers were eliminated at this stage because they did not satisfy all of inclusion-exclusion criteria. The few differences between readers at this point were settled by consensus.

Categories for scoring the quality of the individual papers were established by the two readers, and a maximum score and scoring criteria were set for each category. The maximum score for any paper was 100. The categories and maximum scores are shown in Table 3. To illustrate the scoring method, it can be seen that in the category *Individual Birthweights Certified?* the maximum score was 8. In this category, the highest grade of 6-8 was given to those studies that certified birthweights from medical records. A validated self-report was scored 4-5, self-report not validated 0-3, and no clear method described was scored as zero. All of the categories had criteria for scoring that were based on a similar scoring gradient.

## RESULTS

There were only four papers that qualified for scoring in the evidence table under the criteria applied. These were read by both readers, and any differences were settled by consensus. The scores for the four papers were 61, 60, 49, and 31, and the evidence table for these papers is given in Table 4. None of these reports found any relationship between low birthweight and caries development.

## DISCUSSION

One of the four reports examined children at ages of 33 to 52 months, the others saw children at 3 to 5 years of age. Two of the studies used a two-cohort research design, one was a retrospective cohort, and one was a pilot study case-control that used early childhood caries (ECC) as the outcome. All of the studies assessed dental conditions in the primary dentition only. We could find no study that related caries in the permanent dentition to low birthweight, though following a recent report it could be hypothesized that there would be little relationship between low birthweight and caries in the permanent dentition. The longitudinal study referred to reported that the bone mineral density of the lumbar spine was significantly lower at birth in low birthweight infants than in normal birthweight infants, but rapidly increased during the first two years of life and was normal by age 2

(1). Because much of the primary dentition forms during these first two years of life, this finding suggests that low birthweight could be associated with enamel defects and caries in the primary dentition but may have little effect on the permanent dentition, most of which calcifies after that age.

We noted that a good number of studies found relationships between developmental defects of enamel and low birthweight, though we did not specifically study that issue. The literature also seems to accept that developmental enamel defects are more prone to become carious than normal enamel, though again we did not specifically examine that question.

With respect to the Consensus Questions for this conference, this issue seems to be related to numbers 2 and 5. In saying that, low birthweight is clearly a social problem with many health-related implications and is a condition to be prevented as far as possible, but in the specific context of this conference it is related to these two issues.

## *2. What are the best indicators for an increased risk of dental caries infection?*

If low birthweight does turn out to be associated with caries, the link could either be a directly biological one through low immunocompetence, hypoplasia, and other enamel defects, or it could be because low birthweight is so often a marker for deprived social circumstances and all the caries risks that come with it. It could also be a mix of both. A plausible case can be made for a biological relationship. There is evidence that low birthweight infants have lower serum levels of IgG, IgM, and IgA (2), lower antibody titers, lower numbers of circulating T-cells and complement factors (3,4,5). The resulting higher incidence of infections through the first 10 months of life in low birthweight infants is therefore to be expected. By contrast, normal birthweight infants achieved normal immune function by three months (6,7). The reduced immunofunction of the low birthweight infants could result in earlier colonization by cariogenic organisms. However, this hypothesis remains untested.

## *5. How should clinical decisions regarding prevention and/or treatment be affected by detection methods and risk assessment?*

When clinicians are treating a child who was born low birthweight, the child should be considered at risk of caries. Even though a direct link was not established from the limited evidence in this review, such a link is clearly plausible (as discussed above). In addition, low birthweight is usually associated with social deprivation factors that can leave a child at high risk for caries.

There are numerous research needs with respect to low birthweight, and the difficulties in conducting research with this population are considerable. Cases of low birthweight are found most often when the mother is of low socioeconomic status, <17 or >34 years of age, or smokes. Low birthweight infants are at risk of myriad other conditions, and it will not be easy to separate out all these factors to establish the link between low birthweight and subsequent development of caries.

While we found no direct evidence to say that low birthweight is a risk factor for caries in this review, the results are based on very limited evidence. We therefore cannot reject the possibility that there is a link between low birthweight and subsequent development of caries. It could well be that the neutral conclusions of this review could be largely because the studies were not conducted over a long enough period of time, did not have adequate numbers, and did not collect sufficient information on likely variables affecting the outcome. While the natural conclusion is that more research is needed, the difficulty in conducting studies that do all these things should not be underestimated. It is unlikely that extensive and expensive studies of this nature could be justified solely to look at dental caries as the only outcome, so there should be dental components of large-scale studies which look at the medical and social implications low birthweight.

Further research issues include the link between developmental enamel defects and caries, and the role of birth complications, frequently with the use of ventilators and intubation, in the later development of caries. Studies should also be conducted with older children to relate the effect of low birthweight on the permanent dentition. With results from such studies, the role of low birthweight as a risk factor for dental caries would be better understood.

## REFERENCES CITED IN THE TEXT

1. Ichiba H, Shintaku H, Fujimaru M, Hirai C, Okano Y, Funato M. Bone mineral density of the lumbar spine in very low birthweight infants: a longitudinal study. *Euro J Pediatr* 2000;159:215-8.
2. Ballou M, Cates KL, Rowe JC, Goetz C, Desbonnet C. Development of the immune system in very low birth weight (less than 1500 g) premature infants: concentrations of plasma immunoglobulins and patterns of infections. *Pediatr Res* 1986;20:899-904.
3. Chandra RK. Concentrations and production of IgG subclasses in preterm and small-for-gestation low birth weight infants. *Monogr Allergy* 1988;23:156-9.
4. Chandra RK, Ali SK, Kutty KM, Chandra S. Thymus-dependent lymphocytes and delayed hypersensitivity in low birth weight infants. *Bio Neonate* 1977;31:15-8.
5. Chandra RK, Matsumura T. Developmental aspects of cell-mediated immunity and findings in low birth weight infants. *Indian J Pediatr* 1980;47:103-7.
6. Chandra RK. Nutritional regulation of immunity and infection: from epidemiology to phenomenology to clinical practice. *J Pediatr Gastroenterol Nutr* 1986;5:844-52.
7. Chandra RK. Serum thymic hormone activity and cell-mediated immunity in healthy neonates, preterm infants, and small-for-gestational age infants. *Pediatr* 1981;67:407-11.

## REFERENCES CITED IN THE REVIEW

8. Fearne JM, Bryan EM, Elliman AM, Brook AH, Williams DM. Enamel defects in the primary dentition of children born weighing less than 2000 g. *Br Dent J* 1990; 168:433-7.
9. Lai PY, Seow WK, Tudehope DI, Rogers Y. Enamel hypoplasia and dental caries in very-low birthweight children: a case-controlled, longitudinal study. *Pediatr Dentistry* 1997; 19:42-9.
10. Li Y, Navia JM, Bian JY. Caries experience in deciduous dentition of rural Chinese children 3-5 years old in relation to the presence or absence of enamel hypoplasia. *Caries Res* 1996; 30:8-15.
11. Peretz B, Kafka I. Baby bottle tooth decay and complications during pregnancy and delivery. *Pediatr Dentistry* 1997; 19:34-6.